- Mucool - Linac area development -
Relief valve calculations

HYDRONGEN RELIEF VALVE SIZING FOR THE MUCOOL LH2 ABSORBER

Relief Valve for the main hydrogen abs (6.87 liter)

Calculation of the relief flow capacity

CGA S-1.3-1995 sizing of the primary relief valve as per paragraph 5.2.2

Vessel MAWP (psig)	17.630	(P)	
Flow rating pressure (psia)	39.119	P	*CGA p10*
vi, specific volume of liquid relieved (ft^3/lb)	0.243	V	*6.8 l=0.24 ft^3*
C: cst of gas of vapor related to ratio of specific heat	357.000	C	
Z: compressibility factor a the temperature T and flow rating pressure P	1.000	Z	
M: molar weight of fluid	2.020	M	
Temperature at maximum flow rate (R)	44.820		
Relief valve flow capacity in SCFM of air - loss of insulation vacuum	**3.217E-04**		
F (correction factor for heat transfer)	1.000	F	
Gu, gaz factor for ininsulated container	45.800	Gu	
Mean of absorber surface area (in+out) (square feet)	1.978	A	
Relief valve flow capacity in SCFM of air - fire case	**80.13**		
V (SCFM)	80.126		
M (hydrogen)	2.020		
W, flow capacity (lbs/hr)	**25.6**		

$$Qa = \frac{0.0085 * PV}{C}\sqrt{\frac{M}{Z}}$$

$$Q = a\,F * G\ * uA\hat{}0.8$$

$$W = \frac{M * V}{6.32}$$

Calculation of the relief valve area

W (lbs/hr.)	25.610	
V (SCFM)	80.126	
M (hydrogen)	2.020	
Temperature at maximum flow rate (R)	44.820	
Z (-)	1	
C (hydrogen)	357.000	
Kd, coeff. of discharge	0.9575	
Kb, capacity corrector factor	1	
P1, upstream relief pressure (psia)	39.1	
Area, of the relief valve (in^2)	**0.353**	
Area, of the relief valve (in^2)	**9.021E-03**	
Comparison with the absorber nozzle geometry		
dh2ct (in)	0.750	
The cooling tube area is (in^2)	**0.442**	

$$A = \frac{W\sqrt{TZ}}{CK_bK_dP_1\sqrt{M}}$$

$$A = \frac{V\sqrt{MTZ}}{6.32CK_dK_bP_1}$$

C/C for the worst case scenario (fire) the section of the current nozzle will be enough to evacuate the hydrogen flow